Assessing Solid State Lighting Products and Projects for Funding

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ABSTRACT

This paper presents a proven approach to assessing solid state lighting (SSL) products and projects in an environment that is advancing at an unprecedented rate. Efficiency programs across the country have been relying on the Federal Department of Energy and the Environmental Protection Agency to qualify fixtures. However, both the government and the lighting industry have been moving too slowly for the demand of project funding to be met. Efficiency program implementers in the Northeast are collaborating on an effort through the Northeast Energy Efficiency Partnership's (NEEP) Design Lights Consortium (DLC) to responsibly advance the SSL market in the region.

The technology of LED and other solid state lighting has been advancing fast. In fact, it is advancing too fast for agencies of the federal government to provide effective support for determining the effectiveness and quality of SSL products for the commercial and industrial sectors. In addition, manufacturers are developing and modifying SSL fixtures at a pace that makes it difficult for them to adhere to testing and qualification procedures. Efficiency program implementers are getting inundated with requests for financial support of SSL projects and have had little upon which to evaluate products and projects.

This paper explores the approach taken by the implementers of efficiency programs in the Northeastern United States, who are cooperating on a program to evaluate SSL products and projects. The program is a project of the successful DLC effort that previously provided early promotional and technical support for High-Performance T8s, indirect lighting, high intensity fluorescent fixtures, and efficient design templates. Programs in New York, New Jersey, Rhode Island, Connecticut, Massachusetts, New Hampshire, Vermont, and Maine are collaborating on this effort.

For technical assistance on this program, the Lighting Research Center at Rensselaer Polytechnic Institute won a contract to review lighting fixture technical data and test results for the qualifying of products for program funding. In addition, the DLC participating programs collaborate on methodologies for assessing SSL projects as a critical step in assuring long-lived, cost effective performance.

The paper presents case studies combined with accounts of the technical, market, and political barriers hurdled to provide a blueprint for incorporating fast advancing technologies into programs that must meet quality and cost-effectiveness criteria.

Introduction

Solid State Lighting (SSL) is evolving rapidly, and the demand for this technology by consumers is growing equally as fast. Part of this demand has been fueled by excitement similar to that surrounding the compact fluorescent lamp in its early days, where Solid State Light Emitting Diodes (LEDs) and LED fixtures are being touted to consume almost no energy and have a virtually limitless operating life.

With so much enthusiasm surrounding LEDs, innumerable companies (both old names in the industry as well as many new startups) are getting onboard and are creating their own versions of SSL fixtures. Because of the unique technical challenges of LED technology, quality and performance varies greatly from product to product. Yet while it is nearly impossible to separate fact from hyperbole, this technology does have the potential to become a long-lasting and highly efficient alternative to many light sources we have today. The task for Energy Efficiency programs is therefore to find an objective methodology to differentiate between the products that meet their claims and satisfy customer needs, and those that fall short.

The Need for New Metrics and Procedures

As the struggle to evaluate SSL products grew for efficiency programs in the Northeast, the question was often asked, "Why not just use the same metrics that are in place for traditional lighting technologies to evaluate SSL products?" That approach would certainly simplify things for efficiency program implementers. But unfortunately the situation is complicated. Incandescent, fluorescent, and HID lighting all share a common ancestry and a certain predictability, and the approach to product design, development, and testing is essentially identical among these technologies.

In contrast, SSL technology is completely different. Unlike other light sources, its performance outside a light fixture is not currently predictable. And because the performance of an LED is greatly impacted by the design of the fixture, this requires a whole new skill-set for fixture manufacturers to develop new products. Further complicating the challenge on fixture manufacturers is that LEDs come from an entirely different industry. SSL developers are electronic technicians, not lighting fixture or lamp designers. The challenges they see are similar to the challenges that the early developers of fluorescent and HID lighting faced, rather than the challenges of a mature lighting market.

Developers of testing procedures and implementers of programs must take a fresh look at the market potential of these products and develop testing procedures and qualification criteria that allow the strengths of the products to be recognized, yet makes sure that undo market excitement does not promote the products for inappropriate applications. For example, a color rendering threshold requirement for lighting systems may be perfectly reasonable for considering lighting fixtures for office lighting, but may not be appropriate when considering SSL lighting for a cold-storage facility, outdoor lighting, or accent lighting. In short, testing and qualification criteria must consider the strengths and limitations of the particular technology as it relates to the lighting task at hand.

The heart of the dilemma for energy efficiency programs is that they are unable to determine if manufacturers' claims of performance and useful life are realistic or not. Performance specifications such as input wattage, light output, and the color temperature of the light produced were all subject to the unique conditions and measurement methods determined by the manufacturer, in some cases not even measured. And because LEDs don't suffer from sudden failure, but instead

gradually fade over time, useful life could similarly be defined by the manufacturer. In order to be consistent when evaluating SSL products, a standardized testing procedure that could be applied to all products is essential.

The Industry Drive Toward Acceptance

Besides the obvious differences in the technology itself, there is an additional factor that differentiates the SSL market from the general lighting market and applies pressure for market and efficiency program acceptance. It is relatively easy and inexpensive for new companies to enter the traditional lighting market. Fluorescent, HID, and incandescent technologies are mature and the components needed to produce lighting fixtures are readily available and most are "off the shelf." Additionally, the performance - light output, efficiency, lumen maintenance, color performance, and life expectancy - of the components is well-documented and testing and rating procedures have been in place for decades.

By contrast, entry into the SSL market is expensive and full of risks. The research and development involved in bringing SSL products to the market involves a still developing approach to electronic circuitry, thermal protection, and optical design. Bringing a product to market involves a multi-million dollar investment. Osram-Sylvania reports that the recent SSL lighting expansion in Massachusetts includes a multi-million dollar clean room for the development of new products. And Philips Lighting paid $791 million for the acquisition of Color Kinetics, a firm that specializes in developing and marketing SSL products.

With this capital investment, SSL producers are eager to have their products accepted by efficiency programs around the country and throughout the world as a direct market avenue, but also as an institutional endorsement of the technology and their particular product lines. They are also eager for the finalization of standardized test procedures and the development of an established third-party testing industry to remove some of the risk and investment involved in internal product testing. Their competition is moving fast and staying close to the front is critical to survival in the marketplace. Competition comes not only from their domestic competitors, but also from China and Korea where SSL development has been fast-tracked.

A Brief History of DOE and EPA Efforts

ENERGY STAR is a program run by the US Environmental Protection Agency (EPA) and the Department of Energy (DOE), the purpose of which is to identify and promote energy-efficient products. Identifying whether or not an SSL product has received the ENERGY STAR label is therefore a preferable method for efficiency programs to determine if an LED fixture is a quality product. Relying on the ENERGY STAR label also prevents efficiency programs from spending countless hours reviewing technical data to see if a product is eligible for incentives, and makes it easier for Efficiency Program participants and vendors to identify products that will be eligible for incentives.

Key to the success of ENERGY STAR is the validity of the technical criteria, and the accuracy of testing procedures involved in qualifying products for the ENERGY STAR label. Traditionally the EPA and DOE work in conjunction with one another in order to develop these standards for different technologies. During the summer of 2008, however, the two agencies had published different ENERGY STAR criteria for many identical SSL applications. This resulted in a great amount of confusion amongst the SSL industry. Neither manufacturers nor efficiency programs

had a specific point of reference to determine if a product satisfied all of the ENERGY STAR criteria.

Given the response by the SSL industry resulting from this confusion, as well as congressional pressure for the two agencies to resolve their differences, the EPA and DOE are currently (late 2009) undergoing structural changes with regards to the ENERGY STAR program. One expected goal of this restructuring would be a clear and consistent set of ENERGY STAR criteria for SSL products. While the two agencies better define their roles within ENERGY STAR and criteria become available, the industry is pushing ahead and manufacturers and program implementers are developing alternative methods for assessing the performance of SSL products.

The IESNA – LM-79 and LM-80 Methodologies

In order to create a standardized product evaluation methodology that could be applied to all SSL products, the industry has turned to the Illuminating Engineering Society of North America (IESNA). The IESNA, or IES, develops light measurement procedures that are used throughout the lighting industry. For example IES LM-63 defines a standardized format for presenting photometric test information. LM-79 and LM-80 were developed specifically for the SSL range of products. Through guidance and encouragement from the DOE SSL team, IES developed these standards in record time.

LM-79 Electrical and Photometric Test

The IES developed a method for measuring multiple characteristics of SSL products, including luminous flux, electrical power, luminous intensity distribution, and chromaticity. This method, known as IES LM-79, defines the testing conditions, equipment, and procedures to arrive at an objective conclusion regarding an SSL product's performance. Efficiency programs have since required the results from this test procedure from the manufacturer to be completed at an independent testing laboratory to ensure neutrality in order to have definitive data on the performance characteristics of SSL products.

LM-79 test results provide an accurate record of an SSL fixture's electrical and photometric performance, including its efficacy. Program managers use this information to assure their customers and themselves that the fixture in question will meet the desired performance at the desired efficiency. Table 1 below shows a summary of the LM-79 testing for a group of downlights.

Table 1. CALiPER Summary of LM-79 Testing for a Group of Downlights

-- SSL testing following IESNA LM-79-08 -- 25°C ambient temperature	DOE CALiPER TEST ID	Total Power (Watts)	Output (Initial Lumens)	Efficacy (lm/W)	CCT (K)	CRI
SSL Luminaires						
Downlight (4" recessed)	09-44*	10	490	47	2727	93
Downlight (6" recessed)	09-61	8	*269*	*32*	2779	83
Downlight (6" recessed)	09-69*	39	1110	*28*	3385	91
Downlight (6" recessed)	09-70	30	683	*22*	3334	86
Downlight (6" recessed)	09-75	23	843	37	3456	83
CFL Benchmark (BK) Luminaires						
Downlight (6" recessed) CFL	BK 09-45	28	872	31	3166	83
Downlight (6" recessed) CFL	BK 09-66	33	952	29	3392	82

Values are rounded to the nearest integer for readability in this table.
Performance levels that do not meet the minimum ENERGY STAR criteria for downlights are shown in *red italics*.[3]
*For products 09-44 and 09-69, three samples of each were tested. Values present averages of three samples.

LM-80 Lumen Maintenance/Useful Life Test

Because of their unique aging characteristics, the useful life of LEDs cannot be measured using the same standard as, for instance, linear fluorescent lamps. This standard is defined as the duration of time after which 50% of the lamps would fail. Instead, the end of life for LEDs is determined to be the point at which it produces 70% of its original light output. Research has found that people are able to notice a change in light intensity exceeding 30%, e.g., when reducing lighting levels for load curtailment, building operators can reduce light levels by 30% without complaints by occupants. Thus, this is the level of light output reduction used to signify end of useful life for LEDs.

LM-80 is the standard developed by the IES, used to measure SSL light sources' and modules' lumen output over time. This differs from LM-79 in that it is not evaluating the lamp or fixture as a unit, but rather only the LED package used in such products. In this standard the LED module is tested at three different case temperatures: 55° C, 85°C, and a third temperature chosen by the manufacturer. For a duration of 6,000 hours at minimum, the light output of the LED package is observed and recorded at each of the three temperatures.

In order to determine the lumen maintenance of the final SSL product, including the LED package and the fixture or housing it is used in, LM-80 test results are used in conjunction with UL temperature measurements for the SSL product (ANSI/UL 1598-04or ANSI/UL 153-05) to determine the LED junction temperature. Junction temperature is a key component in predicting the life of an LED chip. A higher junction temperature equates to a more rapid depreciation of lumen output by the LED. Many LED module designs incorporate fin-like aluminum heat sinks in order to keep the junction temperature down, thus extending the life of the product. Knowing the lumen maintenance of the LED package at three given junction temperatures, as well as the operating temperature of the product itself, one can calculate how the LED package will perform when incorporated into a given fixture or housing.

It is important to note that this testing standard does not provide a method for extrapolating lumen maintenance *beyond* the testing period of 6,000 hours. There is a standard being developed for completing this calculation, titled IES TM-21. This standard is currently under development by

an IES committee. It is expected to provide a method for extrapolating the 6,000 hour LM-80 lumen maintenance data to predict the useful life of an LED fixture or product.

The thermal characterization results are summarized in the table below. In all cases, both TS and TA meet or exceed the IES LM-80-08 limits (i.e., TS ≥ 55°C or 85°C, and that TA ≥ TS –5°C). Please note that the following table is taken from a DOE LM80 test; the full test results typically contain 40+ more pages of technical data.

Table 2. LM-80 Tests

Required LM-80 Test Temperature	I_F	Actual T_S	Actual T_A	Actual $\Delta[T_A - T_S]$	Actual Relative Humidity	Average lumen output at 6,000 hours
55°C	350 mA	60°C	64°C	+4°C	18%	0.992
85°C	350 mA	85°C	84°C	-1°C	7%	0.962
108°C *	350 mA	128°C	103°C	–25°C	TBD	0.979

DOE Market Initiatives

The Department of Energy has established multiple programs to promote quality SSL products. Additionally, these programs have been a valuable reference for identifying trends in SSL development and provide an evolving picture of the present state of the technology.

L-Prize

The Bright Tomorrow Lighting Prize, or L-Prize, is a competition with the purpose of developing SSL alternatives to the 60W incandescent and Par38 halogen light bulbs. These SSL alternatives must meet significant performance criteria, which pushes manufacturers to create highly efficient replacements for these two common applications. For example, the 60W incandescent replacement must have an input wattage no greater than 10W, deliver at least 900 lumens, and have a useful life of greater than 25,000 hours. To put it in perspective, a typical 60W incandescent delivers the same amount of lumens while drawing six times the amount of energy and has a life of only about 1000 hours. There is also a third-prize category that is not yet defined, but has been termed the 21st Century Lamp.

The prizes are substantial but are not fully determined. The following is taken directly from the DOE's L-Prize Website: "Subject to the availability of funds, the Energy Independence and Security Act of 2007 (EISA); Subtitle E; Section 655, provides for cash prizes in the amounts of $10,000,000 for the first successful product in the 60-watt incandescent lamp category and $5,000,000 for the first successful product in each of the PAR 38 and 21st Century Lamp categories. Actual cash prizes are subject to the availability of appropriated funding from future appropriations and private funding contributions as authorized by the EISA."

Quality Advocates

The DOE Quality Advocates initiative is a voluntary pledge program developed to ensure that SSL products are labeled accurately. In the early stages of SSL development, many claims with regard to input wattage and correlated color temperature (CCT), among others, were highly inaccurate and unsubstantiated. Manufacturers who make the Quality Advocates pledge agree to provide the most accurate information available for their products. This is achieved by using the Lighting Facts label, which provides a brief summary of the LM-79 test results for a given product.

Gateway Demonstrations

The DOE Gateway Demonstrations present real-world installations of SSL products in a variety of applications and environments. The installations are monitored and recorded and provide information on how SSL products perform. A summary report for each installation is created that analyzes the site and products used, the cost-effectiveness of the project, and a comparison of performance and energy savings between the SSL products and the fixtures previously installed. Additionally, surveys are taken in order to gauge the public response to the retrofit. These demonstrations provide good information about how certain SSL products perform in actual installations and are valuable in comparing manufacturer's claims with actual performance data.

CALiPER

The DOE's Commercially Available LED Product Evaluation and Reporting program, or CALiPER, regularly completes independent testing on a wide variety of SSL products. Each round of testing evaluates the performance of multiple SSL products that are presently available on the market. Testing includes that outlined in IES LM-79 and additionally includes a temperature measurement of what is considered to be the hottest point on each product. DOE procures the test samples from market channels using "mystery shoppers," so that they are testing market examples, not manufacturers' exemplars. Each round of testing includes a summary report, which is a valuable glimpse into the current state of SSL technology.

Design Lights Qualified SSL Products List Program

Energy efficiency programs, operated by electric utilities and state organizations, promote energy savings through either prescriptive equipment rebates or through custom incentives for deemed energy savings. These programs have a responsibility, both to their regulators and to their funders (ratepayers and/or taxpayers), to ensure that products installed will meet customer expectations and provide lasting energy savings, as claimed by the program. This has the result of making efficiency programs very cautious when incorporating cutting-edge or unproven technologies such as LEDs. With many technologies and products the programs have traditionally leaned on ENERGY STAR labeling to indicate assurance of quality and performance. However, ENERGY STAR for SSL does not yet cover many of the SSL product types and applications that are being proposed to efficiency programs.

Efficiency programs in the Northeast saw a need to develop a centralized methodology to differentiate the high-quality products they were looking to support. Through Northeast Energy Efficiency Partnerships (NEEP), several programs came together to initiate a qualifying procedure and establish list of qualifying SSL products. The SSL Qualified Products List (QPL) Program is an expansion of an existing effort termed the DesignLights Consortium (DLC), which was originally

formed to provide the region with a set of guidelines for efficient lighting designs for new construction and major renovations.

NEEP's DesignLights Program includes sponsors from all the New England states, New York, and New Jersey. However, due to the need to evaluate SSL products, many other utilities and efficiency programs from outside the Northeast have asked to join the Consortium. The DLC has now grown to include all the original NEEP sponsors plus the Mid West Energy Efficiency Alliance (MEEA), Wisconsin Energy Conservation Council (WECC), the Northeast Energy Efficiency Alliance (NEEA), Electric Utility Market Managers of Texas, Canada's two largest utilities (BC Hydro and Hydro Quebec), and most of California's utilities: PG&E, SMUD, SCE, SDG&E. See the full list at www.designlights.org.

By using the DOE ENERGY STAR SSL qualification process as a platform, the DLC consortium has developed specifications for new categories of products that are not covered by ENERGY STAR and a qualification process for manufacturers to submit their products.

The DLC's criteria focus on product quality and performance and endurance, as well as cost-effective energy savings. As manufacturers and vendors propose products for an SSL project with any DLC member program, they are required to supply proof of ENERGY STAR labeling (assuming the product fits one of the ENERGY STAR categories) or submit test data and pass qualification for the DLC Qualified Products List.

To qualify the product, the DLC requires the following:

A. IESNA LM-79-08 Photometric (Goniophotometry) Test Report (Formatted to LM-63-03)
B. IESNA LM-79-08 Integrating Sphere Output Report
C. For Lumen Maintenance, either:

   Option 1
   - LED Package Manufacturer LM-80 Test Report with results showing relative light output over time
   - In situ temperature measurement test (ISTMT) showing measured TMP_{LED}
   - Diagram or photograph of the Temperature Measurement Points for the package array of module

   Option 2
   - IESNA LM-79-08 Test Report at time = 0 and 6,000 hours respectively.

D. For the Power Supply:
   - In situ temperature measurement test showing measured TMP_{PS}
   - Diagram or photograph of the Temperature Measurement Point
E. Warranty information

DLC analysts examine manufacturer submissions for completeness and fixture performance. They verify that test results are consistent with manufacturer claims and that they are reasonable. Then they confirm that the fixture meets DLC's performance specifications for its product category. A fixture which "passes" is added to the Qualified Product List.

The resulting QPL is available for use by DLC sponsors for use in their energy efficiency programs. The program managers may add fixtures from the list to their prescriptive program offerings, assuming other program criteria are met. Or, when a project is proposed under a custom incentive program, the program managers can verify these products by either checking to see whether the fixture has been approved and listed, or request that the manufacturer apply to have the fixture added to the QPL.

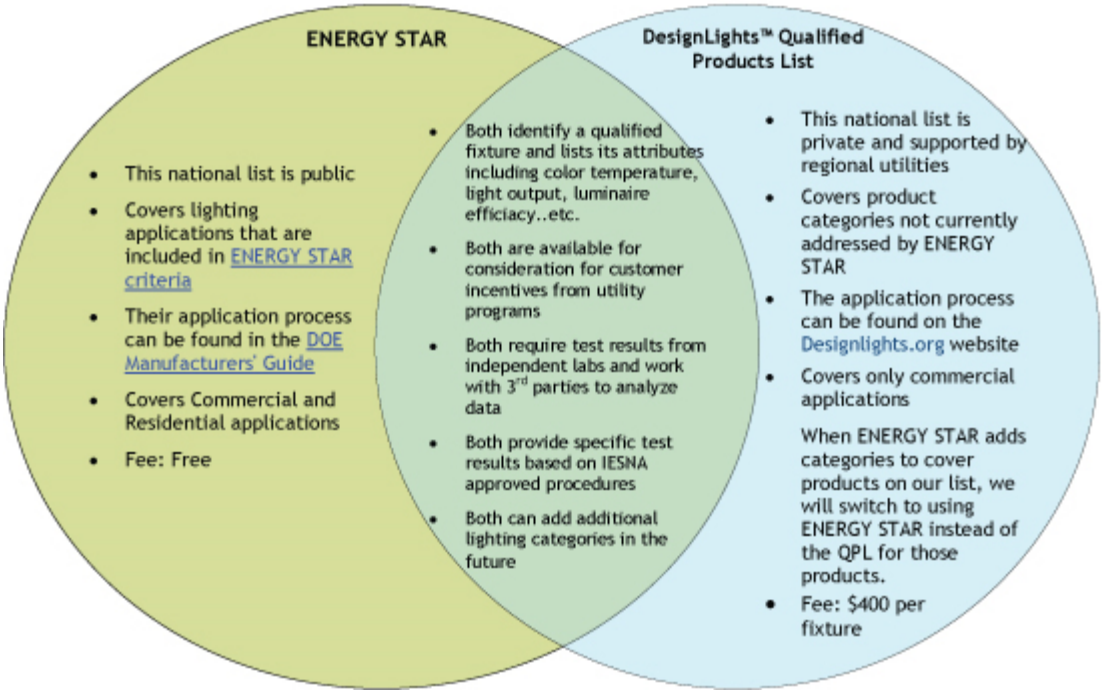
The advantage of having the QPL in use by energy efficiency programs across North America is that manufacturers need to apply only once to qualify a product, for over thirty energy

efficiency programs. And, conversely, thirty program managers are relieved from having to analyze individual products' performance tests.

The year 2009 was one of substantial development for the DLC's QPL. The steering committee, made up of representatives from all sponsors, formulated methods and procedures. They engaged the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute to analyze applications and manage the product list. In October 2009 NEEP finished updating the DLC Web site (www.designlights.org) to automate the QPL application process, and the first applications started appearing in early November.

Initially the program focused on outdoor fixtures, but as soon as the automated application process was in place, work began on additional fixture categories. To date, refrigerator case lights, display case lighting, flat ceiling panel lighting and outdoor retrofit kits have been addressed. With the "exploding" state of the SSL market, this is clearly the tip of the iceberg.

The following chart illustrates how the ENERGY STAR and DLC programs work together:



SSL Project Case Studies

Farnsworth Museum –LED Exhibit Lighting – Efficiency Maine Funded Project

The Farnsworth Museum located in Rockland, ME has 20,000 square feet of gallery space and has been illuminating their artwork with 482 incandescent Par30 lamps at 75 watts each. The museum approached Efficiency Maine with a proposal to replace each one of the 75W incandescent lamps with 15W and 9W (spot and flood) LED screw-in Par30 lamps. The museum was particularly interested in using SSL lamps because along with the energy savings, they emit very low levels of ultraviolet and infrared radiation, both of which contribute significantly to the fading of colors and the overall aging of artwork. On the surface the project appeared to be very attractive, reducing their electrical demand 32kW at a cost that carried a simple payback of 2.4 years. However, the claims by the manufacturer needed to be substantiated, and LM-79 and LM-80 test reports were requested. At the time, neither report was available from the manufacturer, which immediately raised concerns over the validity of the manufacturer's claims of performance and useful life.

After discussions with both the Farnsworth Museum and the SSL manufacturer, LM-79 test reports from an independent testing laboratory were obtained. However, LM-80 test results were not available for two primary reasons: the cost of the test and the time required to complete it. As an alternative to this requirement, Efficiency Maine worked with the manufacturer to create a warranty agreement that addressed the lumen maintenance of their product. It was determined that in order to see a return on the investment associated with providing incentives for the implementation of this project, Efficiency Maine would need to be guaranteed that the SSL product would be operable for at least 5 years. The warranty agreement was written such that if the product failed or if the light levels dropped below 70% the initial lumen output within 5 years of the installation date, than the product would be repaired or replaced. This project has been approved by Efficiency Maine and is currently being installed as this paper is being prepared.

East Brown Cow Management – LED Security Lights – Efficiency Maine Funded Project

East Brown Cow Management, a commercial property management company in Portland, ME, applied to Efficiency Maine for incentives to replace fifteen outdoor wall pack security lights with eleven SSL fixtures at one of their properties. The existing fixtures utilized a variety of technologies, including metal halide, mercury vapor, and high pressure sodium. Part of the appeal for East Brown Cow Management in switching to LED fixtures included their inherent directionality and the resulting ability to put light exactly where it is needed. The existing fixtures consumed a comparatively large amount of energy, much of which was in the form of wasted light.

The manufacturer of the SSL products was showcased in multiple DOE Gateway demonstrations and was also included in the CALiPER tests. Based on the results of these initiatives, as well as communication with other efficiency programs, it was agreed that this manufacturer created high-quality SSL products. And because of their involvement in the CALiPER tests, LM-79 documents for the proposed wall packs were directly available from the DOE Web site. However, LM-80 test results were not available for these products because at the time the proposal was submitted, the LM-80 standard was still new and its adoption was not yet unanimous within the industry. After communicating with the manufacturer, they agreed to provide a 5-year warranty that would cover their product if light levels dropped below 70% of the initial light output, similar to the warranty used with the Farnsworth Museum, in place of the LM-80 test documents. This warranty

fulfilled Efficiency Maine's remaining requirements and this project is nearing completion and will be on-site reviewed prior to the presentation of this paper at the AESP event.

Scarborough Public Library – Outdoor Area Lighting - Efficiency Maine Project Rejected for Funding

The Public Library in Scarborough, ME uses sixteen metal halide fixtures to illuminate its parking lot and outdoor walkways, including nine 175W units and seven 70W units. They submitted an application to Efficiency Maine that proposed to replace these fixtures with SSL equivalents, including nine 81W units and seven 36W units, respectively.

The products submitted had the required LM-79 testing completed. Based on these test results, the products also met all performance criteria, including minimum light output, fixture efficacy, and zonal lumen requirements. Before making the phone call to request LM-80 test results, the project underwent cost-effectiveness screening, and this application for incentives was ultimately rejected because the project cost was too high. After comparing the material and labor cost against the projected energy savings and utility rate, it was determined that this project would have a simple payback of 21.9 years. In order to qualify for incentives through Efficiency Maine, such projects must result in a simple payback that does not exceed 50% of the anticipated life of the project. Despite the lofty predictions of the useful life of SSL products, Efficiency Maine was not confident that the project would remain in service for 45 years. Efficiency Maine and other programs throughout the region have turned down many SSL projects due to the high costs associated with SSL fixtures.

Evans Express Mart – Gas Station Canopy Lighting – Efficiency Vermont Project Rejected for Funding

The Evans Express Mart in White River Jct., VT uses sixteen 320W MH fixtures to illuminate their gas station canopy. A vendor proposed a project to Efficiency Vermont to retrofit the existing sixteen canopy fixtures using an 85W LED Module Retrofit Kit. By using the kit, the existing fixtures and housing would remain in place, but the existing lamp, ballast, and reflector insides would be removed and replaced with the LED module.

Efficiency Vermont requested testing data from the manufacturer to validate claims and ensure a quality product. The manufacturer was able to provide LM-79 testing results for the LED retrofit module, as well as LM-80 data for the LED chip used in the module. However, these testing results were associated with the module by itself, not inside the actual fixture where it would be installed. Because LED performance and longevity can be significantly compromised by the fixture it is placed in, Efficiency Vermont required the manufacturer to test the module inside an actual fixture from the site in order to approve it. Ultimately the manufacturer decided this was not worth the cost, and the vendor was left with a decision to abandon the retrofit kit or use an approved new fixture if they wanted the rebate.

Retrofit LED Kits offer both an opportunity and challenge to efficiency programs. By reusing existing fixtures, installations and equipment costs for LED installations can be reduced while reducing waste. However, the unpredictability of LED technology presents challenges to ensuring that LED Retrofit kits will meet customer expectations and perform as claimed.

Lessons Learned During the First Program Year

This year (2009) was an exciting year for LED technology. LEDs moved from prototypes and niche applications to commercially available products and real installations. DesignLights QPL and ENERGY STAR SSL were launched and gathered their first qualifying products. Lightfair became LEDFair. New LED chip efficacy records were set. Efficiency programs were approached with hundreds of products and potential projects and many supported actual LED installations with great initial success.

All of these new developments are exciting and encouraging, but we are still in a delicate stage of the market. There are many suppliers desperate to make their fortunes on the ground floor, before an eventual shakeout. Many have quality products but many others are pushing low-quality products with unsupported and misleading claims.

It is clear to the responsible members of the lighting community that they need to be vigilant; especially now, early in the market introduction of SSLs. The stakes are too high to repeat the mistakes of CFL introduction, and if we are not careful to demand quality and performance, efficiency programs will be burned again. Our best bet is to use sound tools to assure product quality and to communicate well with all levels of the market: manufacturers, designers, vendors, and customers. This early stage will be hard work, and challenging for efficiency programs, but diligent efforts will pay off.